UNIPOWER

Power Quality Management System

AEDU, Namibia, 2025

Thomas Ottosson, Managing Director

Russom Kebedom, Area Manager

SDIPTECH Infrastructure Technology Group

UNIPOWER

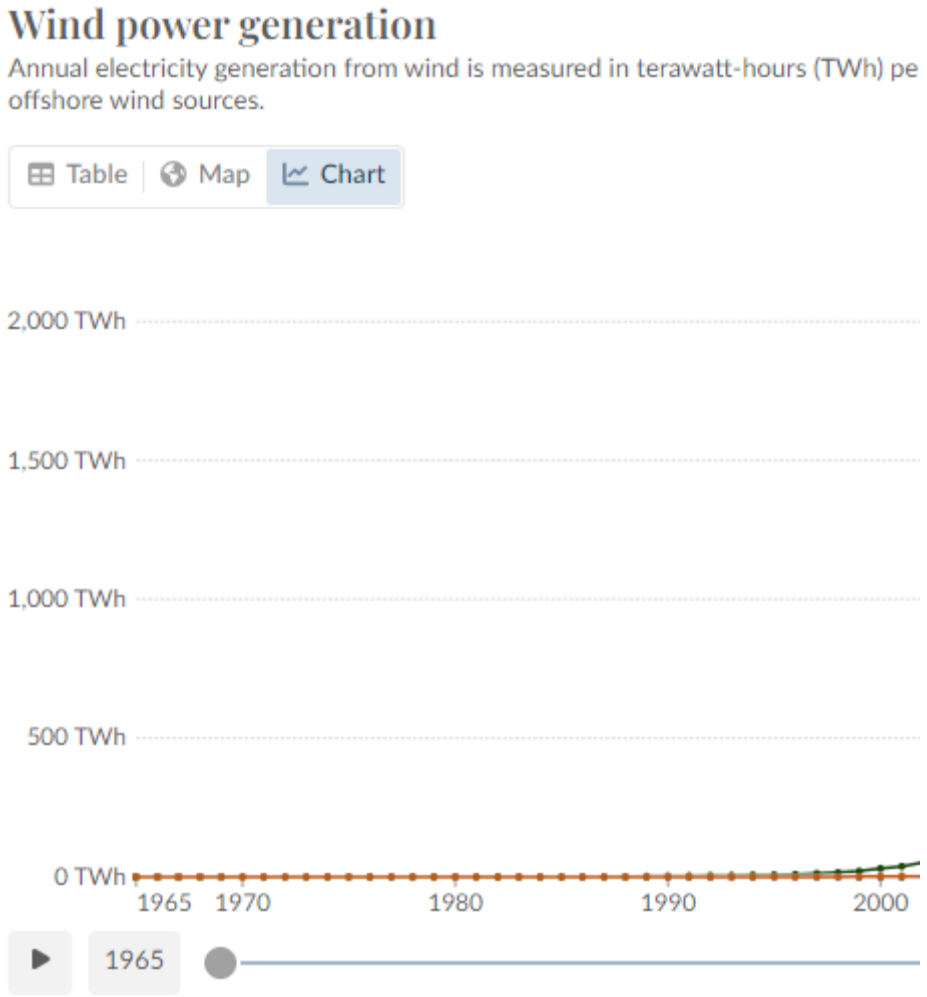
Renewable Energy and Battery Storage

It’s going exponential!

UNIPOWER

Wind

Wind power generation between 1965 and 2000

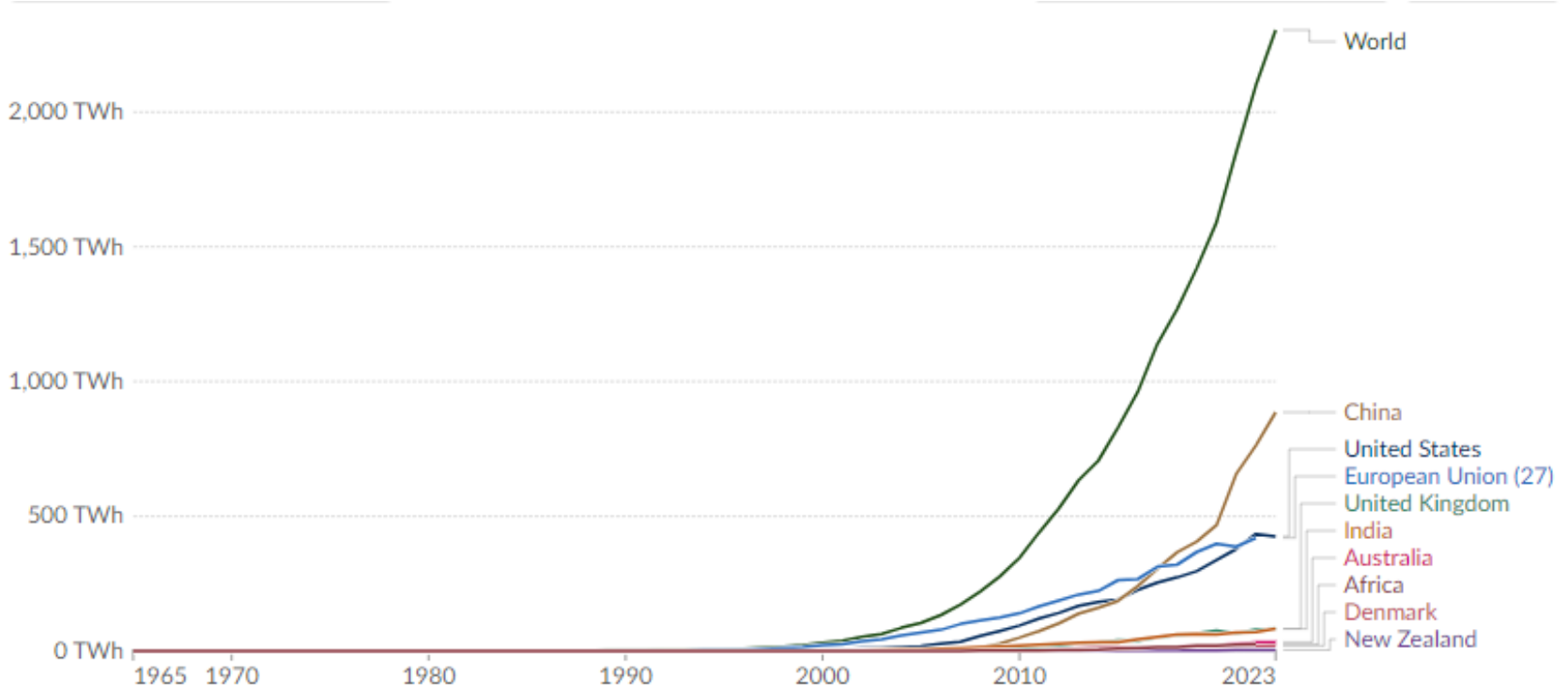


Wind

Wind power generation between 1965 and 2023

0 => 2300 TWh

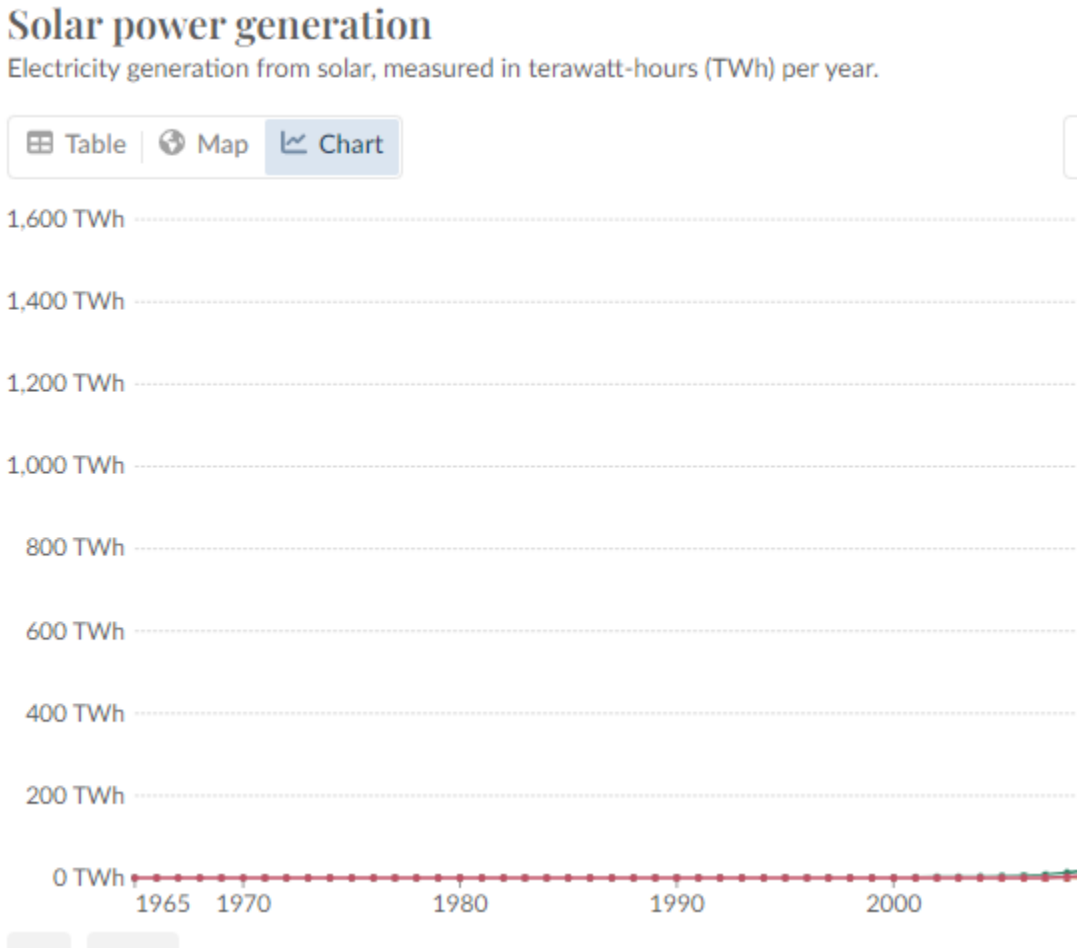
4x Germany's yearly consumption



UNIPOWER

Solar

Solar power generation between 1965 and 2010

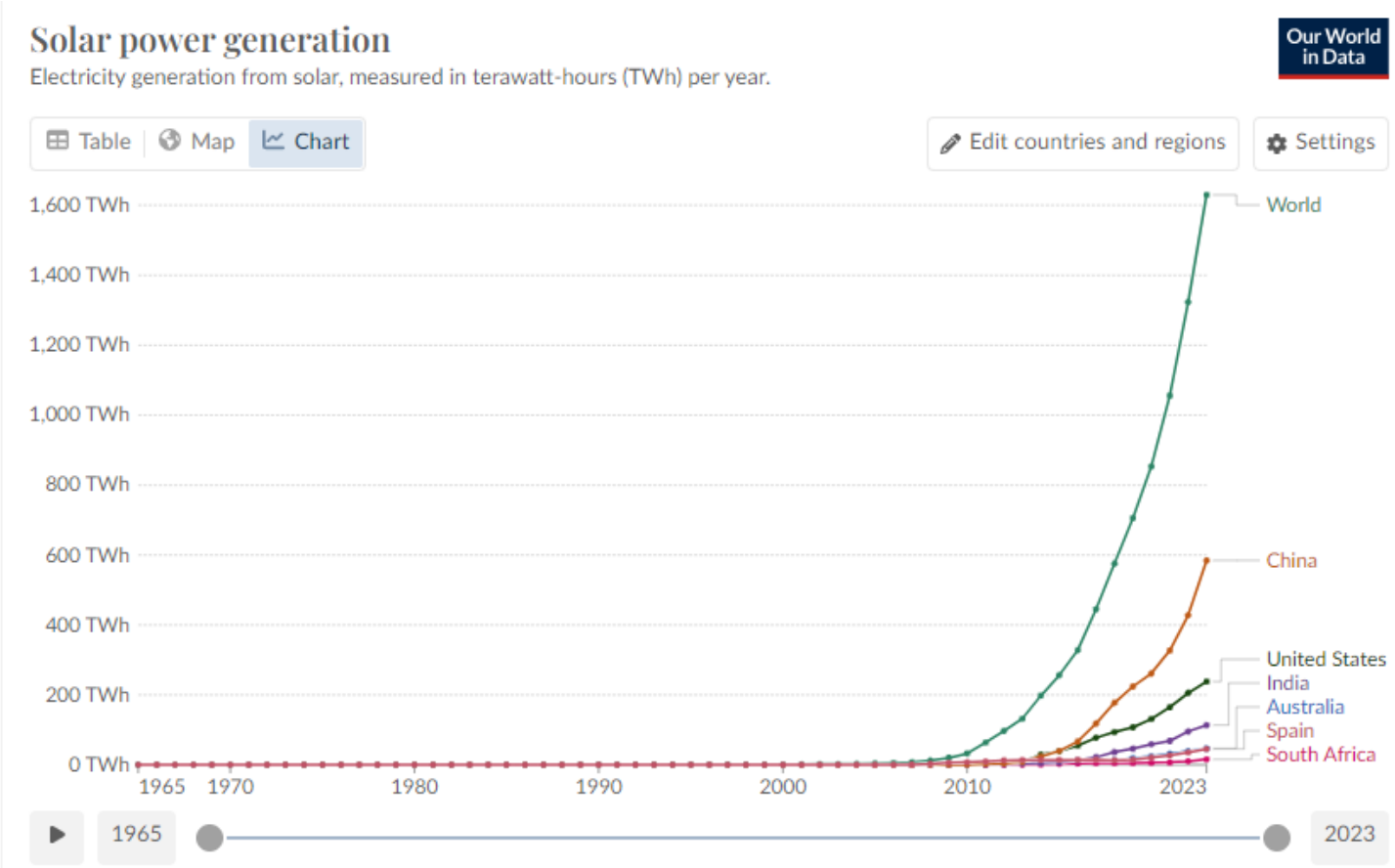


Solar

Solar power generation between 1965 and 2023

0 => 1600 TWh

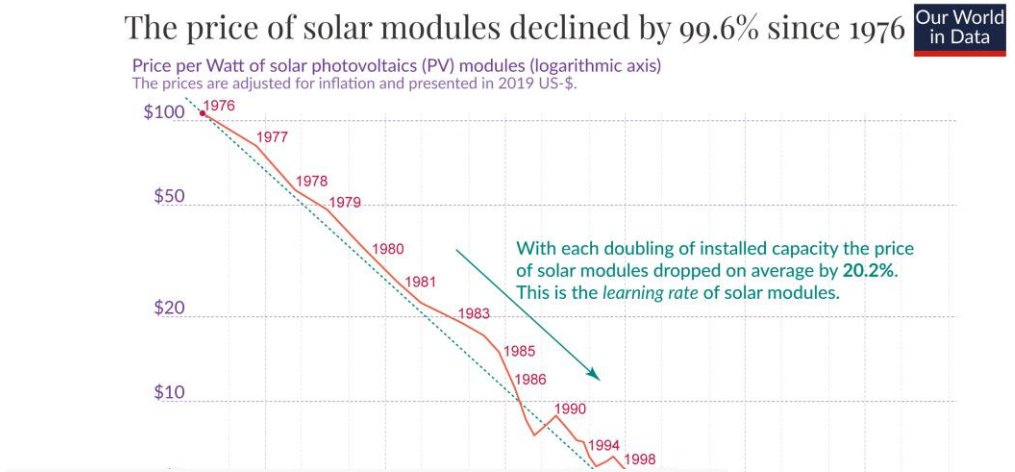
12x Sweden's yearly consumption

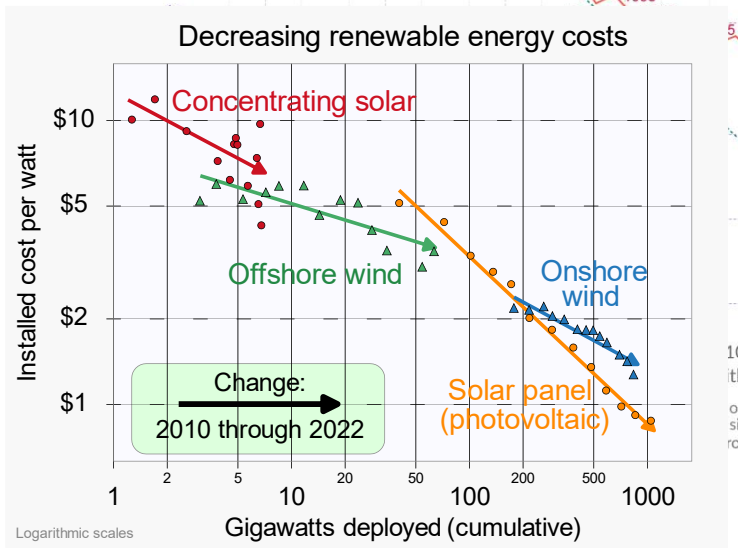


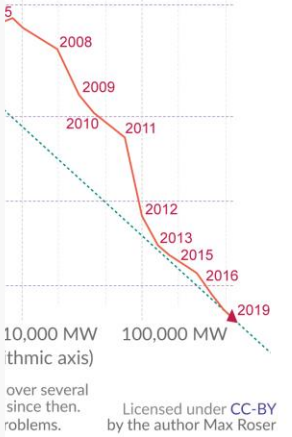
50 years of exponential price decline

The price of PV panels follows 'Moore's Law'... or at least some distant version of it.

-"What is determining the cost of renewable power is the cost of the power plant, the cost of the technology itself."





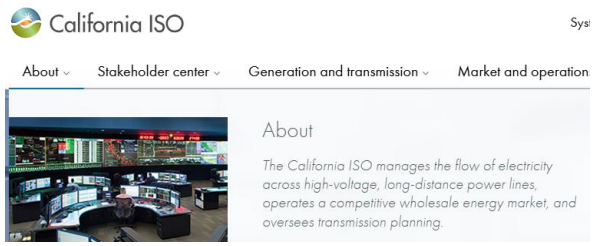


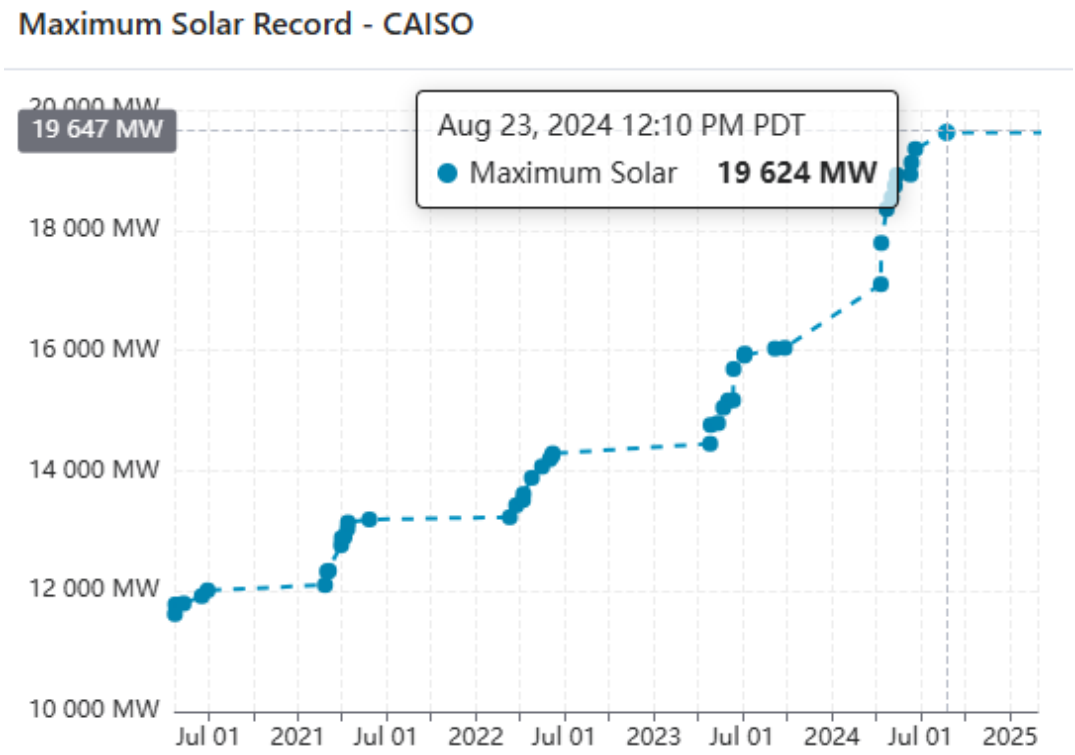
UNIPOWER

Solar Power Records in California

At 12:10 on the 23rd of August 2024, 19.6 GW of solar power was produced.

…That is slightly more than Sweden's peak consumption yesterday (19.1 GW).





UNIPOWER

Energy Mix in Californa

7 days in February

15 GW of solar power at noon

6 GW of battery power after sunset

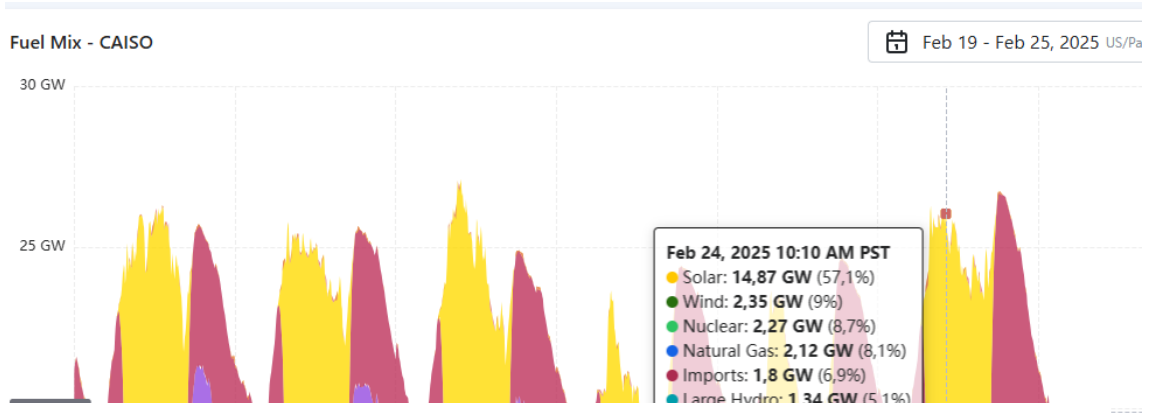
8 GW from imports from other states

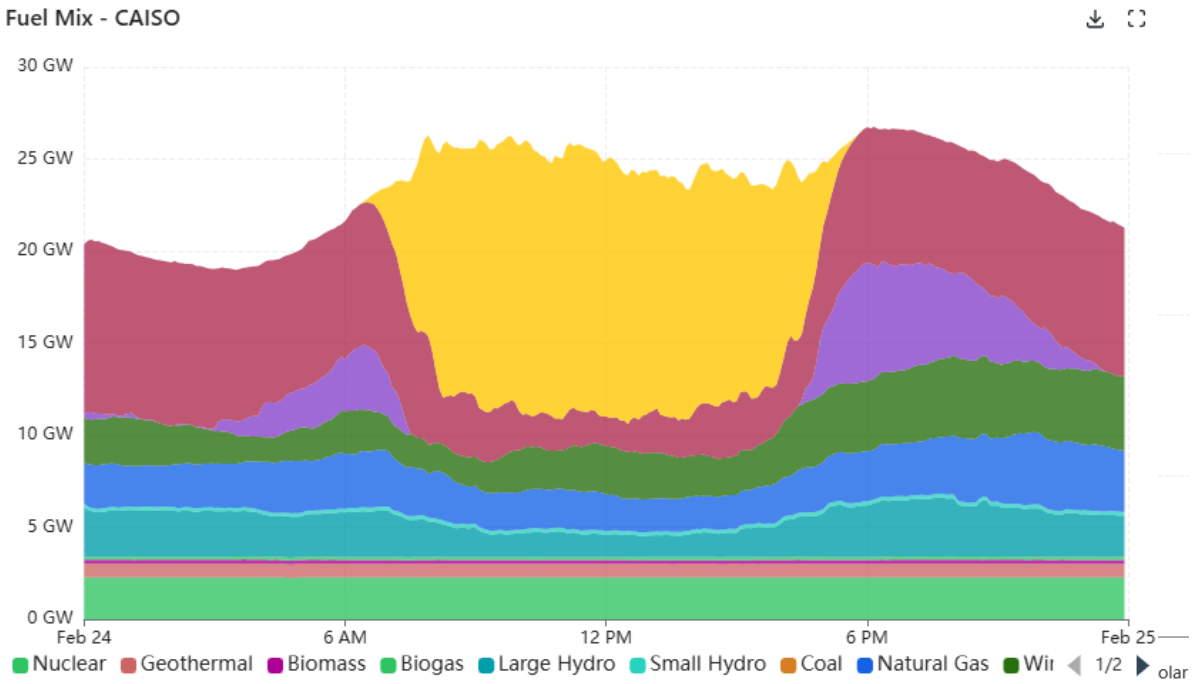
8 GW from natural gas

2 GW of nuclear power

⇒It is possible to build a stable grid with renewables and batteries.

⇒Bonus if you can import power when needed ☺





Battery Storage

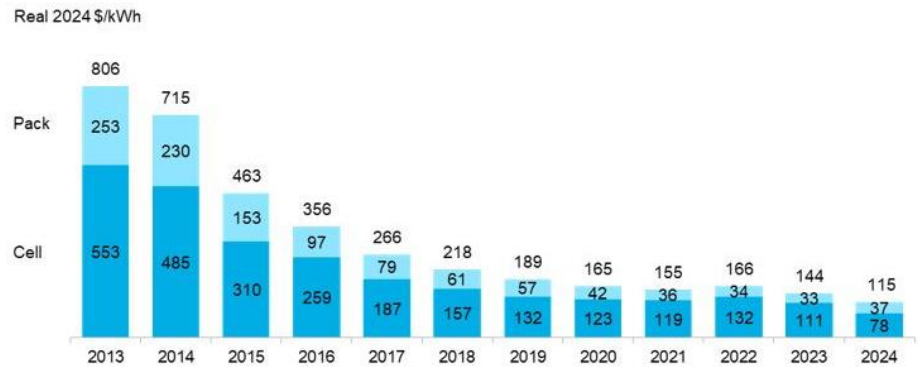
Rapid Price Reduction

From $715/kWh in 2014 to $115/kWh in 2024

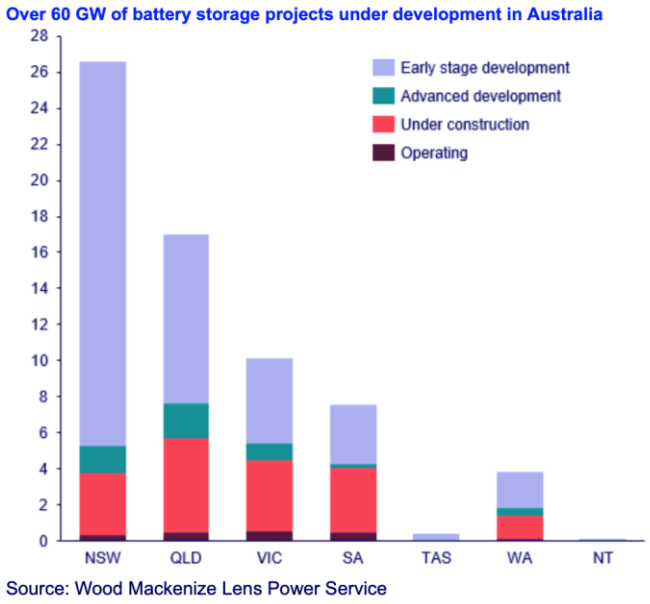
84% price reduction over 10 years

60 GW of battery storage projects in Australia

Figure 1: Volume-weighted average lithium-ion battery pack and cell price split, 2013-2024



Source: BloombergNEF. Note: Historical prices have been updated to reflect real 2024 dollars. Weighted average survey value includes 343 data points from passenger cars, buses, commercial vehicles and stationary storage.



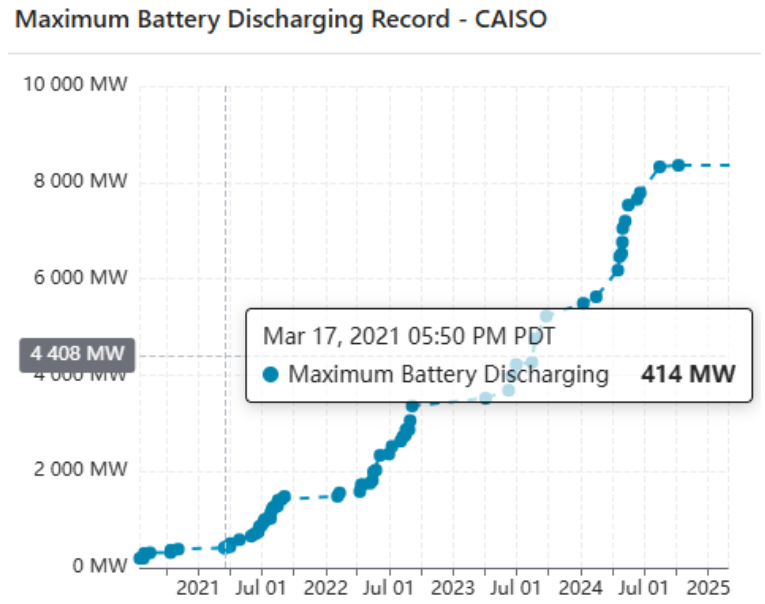
Battery Discharge Record

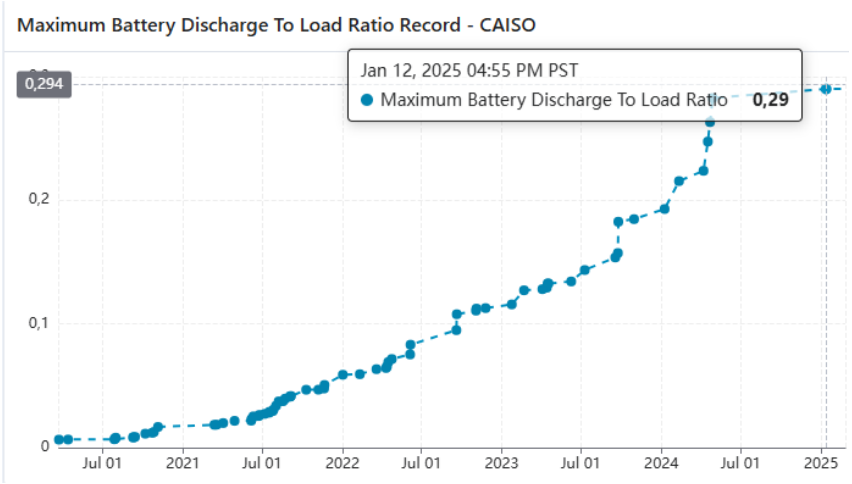
400 MW in 2021

8400 MW in 2024

=> 21 times more power

At 16:55 on the 12th of January, almost 30% of the power come from batteries!





UNIPOWER

Renewables will change our industry!

Distributed energy sources will change the topology and complexity of the grids

UNIPOWER

Conclusions – from a PQ perspective

Ensure **Network Stability**

Detect "**Unknown Unknowns**" effectively

Implement **Real-Time** Measurement and Response

Utilize Accurate **Class A** Data

UNIPOWER

Unknown Unknowns - Continuous scan

Automatic sampling speed depending on event.

PMU absolute phase angle measurements between different locations in the electrical network.

No special setup required

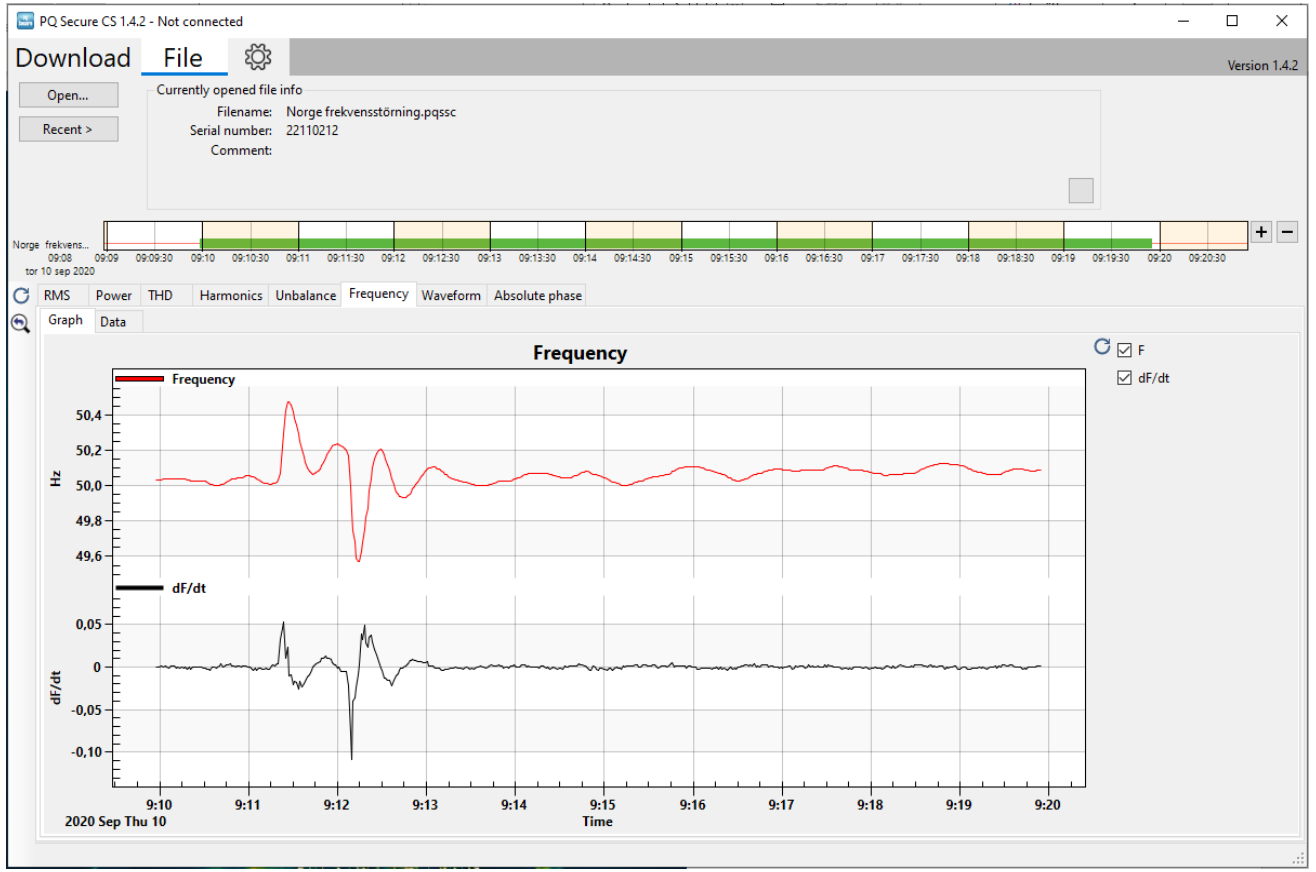
Continuous measurement of all data for several months. Norm compliant power quality measurement at the same time

Waveform presentation with resolution up to 1024 points per cycle

Load balance investigation. Study voltage and active and reactive power

Verifying renewable generation

Detailed study of network performance. Inrush current, filter response



Accurate Data – Class A

Unipower products are class A certified by METAS

[Participating laboratories - BIPM]

Certificate of Conformity No 213-01936

Type description

Type	UNIPOWER UP-2210, UP-2210P, UP-2210R, Unilyzer 900
Classification	UP-2210: PQI-A-FI1-H UP-2210P: PQI-A-FI1-H UP-2210R: PQI-A-FI1-H Unilyzer 900: PQI-A-PO-H as per IEC 62586-1:2017
Mode of connection	Direct or transformer operated instrument
Number of phases	3
Connection to power lines	3P+N
Maximum voltage	500 V
Maximum current	6 A
Frequency	50 Hz, 60 Hz
Hardware version	UP-2210: 2800/221002 UP-2210P: 2800/221008 UP-2210R: 2800/221008 Unilyzer 900: 2800/271003
Firmware version	4.48.542

Conformity assessment against IEC 62586-2:2017

Power quality parameter	Subclause	Compliance 65 V / 5 A – 50 Hz	Compliance 65 V / 5 A – 60 Hz
Power frequency	6.1	Yes	Yes
Magnitude of supply voltage	6.2	Yes	Yes
Flicker, class F1 (230 V / 50 Hz, 120 V / 60 Hz)	6.3	Yes	Yes
Supply voltage interruptions, dips and swells	6.4	Yes	Yes
Supply voltage unbalance	6.5	Yes	Yes
Voltage harmonics	6.6	Yes	Yes
Voltage interharmonics	6.7	Yes	Yes
Mains signalling voltages on the supply voltage	6.8	Yes	Yes
Flagging	6.10	Yes	Yes
Clock uncertainty testing	6.11	Yes	Yes
Variations due to external influence quantities	6.12	Yes	Yes
Rapid voltage changes (RVC)	6.13	Yes	Yes
Magnitude of current	6.14	Yes	Yes
Harmonic current	6.15	Yes	Yes
Interharmonic currents	6.16	Yes	Yes
Current unbalance	6.17	Yes	Yes

Remark: Subclause 6.9 is not applicable.

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Federal Institute of Metrology METAS

Certificate of Conformity No 213-01936

Object	**Power Quality Monitor** **UNIPOWER, Sweden** **UP-2210, UP-2210P, UP-2210R, Unilyzer 900**
Applicant	**Unipower AB** Metallgatan 4C 44132 Alingsås Sweden
Requirements	Certification IEC 61000-4-30:2015, class A Testing according to IEC 62586-2:2017
Confirmation	See page 2
Date of Examination	3 June 2019 to 5 March 2020

3003 Bern-Wabern, 12 June 2020

For the Examination Christian Santschi

Approved by Dr Cédric Blaser, Head of Laboratory
Laboratory Electrical Energy and Power

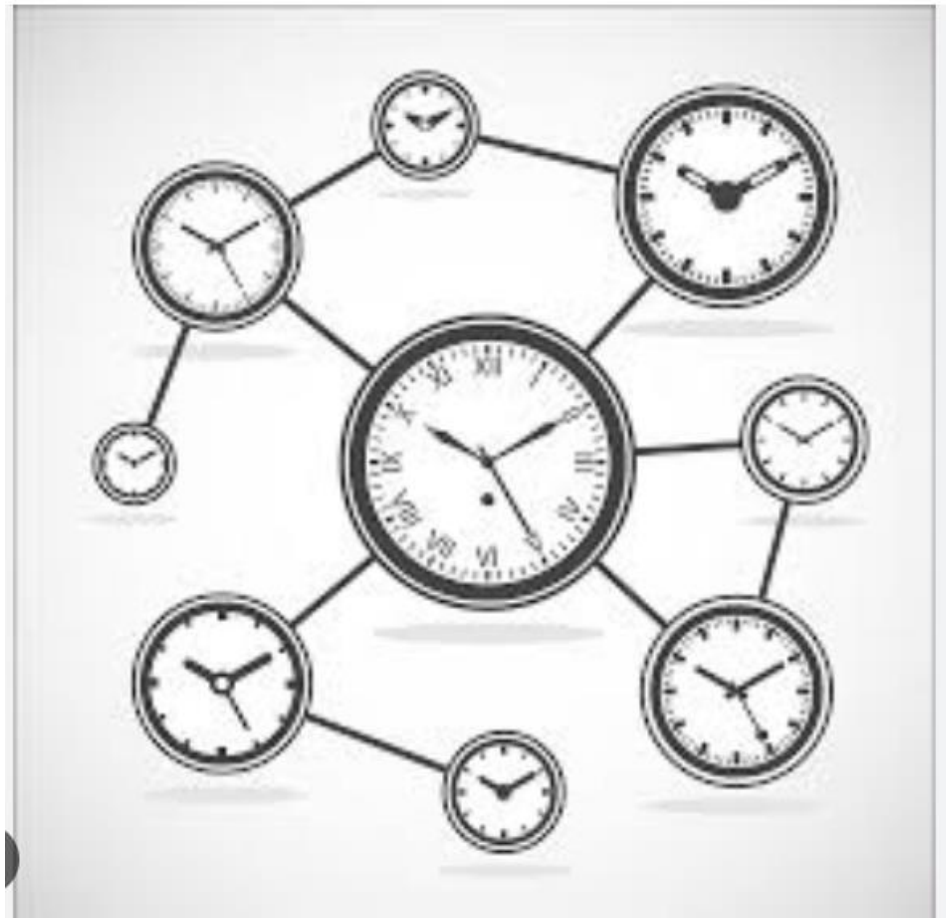
The importance of time-synchronization

To measure correct is to know

What about time?

Our instruments are time-synchronizing

- Global Positioning System (GPS)
  Time-Synchronization
- Network Time Protocol (NTP)
- Master-Slave Synchronization (Schedule server)



Unipower staff representing Sweden in IEC 61000-4-30 Class A, Working Group

Jonny Carlsson

UNIPOWER

Knowledge Transfer/Exchange

Upcoming training sessions:

- Sweden in May
- KGRTC in October